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(54) **Electrical signal bundle**

Drahtbündel für elektrische Signale

Faisceau de fils de signaux électriques

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(56) References cited:
EP-A- 0 734 030
DE-U- 9 005 743

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Description

Field of the Invention

[0001] The invention relates to an electrical cable having an electrical signal bundle for placing within an outer jacket.

Prior Art

[0002] Electrical signal lines are known, for example, from European Patent Application EP-A-0 735 544 (Cartier et al.) assigned to Hewlett-Packard Company. This patent application describes an ultrasound system with a transducer cable for providing an electrical connection between a transducer and a display processor. The third embodiment of the transducer cable in this application uses three layers of extruded ribbon assemblies separated from each other by shield conductors comprising thin strips of bare copper. The stack of ribbon assemblies and shield conductors are extruded with a ribbon jacket to form a desired length of the transducer cable.

[0003] US-A-4 847 443 (Basconi) assigned to the Amphenol Corporation teaches another example of an electrical signal line cable formed from a plurality of generally flat electrical signal line segments stacked together in an interlocking relationship. Each electrical signal line segment of this prior art cable contains at least one signal conductor surrounded on either side by ground conductors. The plurality of ground conductors effectively form a ground plane which inhibit the cross-talk between the adjacent signal conductors. The insulating materials in which the conductors are disposed is extruded over the individual signal conductors.

[0004] European Patent EP-B-0 605 600 (Springer et al.) assigned to the Minnesota Mining and Manufacturing Company teaches a ribbon cable and a lamination method for manufacturing the same. The ribbon cable manufactured comprises a plurality of evenly spaced flexible conductors surrounded by an insulator which is a microporous polypropylene.

[0005] US Patent US-A-4 847 443 (Crawley et al.) assigned to W.L.Gore & Associates teaches a multiconductor flat ribbon cable having a plurality of electrical conductors disposed within an insulator consisting of expanded polytetrafluoroethylene (ePTFE).

[0006] PCT patent application WO-A-91/09406 (Ritchie et al) teaches an electrical wiring composed of elongated electrically conductive metal foil strips laminated between opposing layers of insulating films by means of adhesive securing the foil strips between the laminating films.

[0007] German patent application DE-A-24 24 442 assigned to Siemens teaches a cable assembly which comprises a plurality of flat cables laminated between insulating films.

[0008] PCT patent application WO-A-80/00389 (Clarke) assigned to Square D company of Palatine, Illinois, teaches an input/output data cable for use with programmable controllers. The cable has a ground conductor, a logic level voltage conductor and a number of signal tracks. The conductors are disposed on two or three layers of flexible plastics material in specified ways to give high immunity to interference and low inductive losses. The layers are glued together to form a laminate structure.

Summary of the Invention

[0009] It is an object of the invention to provide an improved electrical signal bundle which may be placed in an outer jacket.

[0010] It is furthermore an object of the invention to provide an electrical signal bundle offering easy termination to termination board.

[0011] It is furthermore an object of the invention to provide an electrical signal bundle whose conductors offer coaxial properties.

[0012] It is furthermore an object of the invention to provide an electrical signal bundle for use in a catheter.

[0013] These and other objects of the invention are solved by providing an electrical signal bundle for placing within an outer jacket and a plurality of coplanar electrical signal conductors encased within an insulator and which form a bundle assembly. The insulator has an insulator top side and an insulator bottom side and a shielding strip is placed on one of the insulator top side or the insulator bottom side. The bundle assembly is helically twisted around a central axis and at least one of the said electrical signal conductors has a characteristic impedance in the range of 50 to 200 Ω. The encasing of the plurality of coplanar electrical signal conductors in an insulator allows the electrical signal conductors to be easily manipulated and connected to a termination board. This offers substantially improved handling over the prior art methods of using a plurality of individual coaxial conductors within a tube in which each conductor must be individually identified and matched to the appropriate connection on a termination board. The insulator ensures that all of the signal conductors within the bundle remain at a known position and thus can be easily identified.

[0014] The shielding strip is used to shield at least some of the conductors from interfering electromagnetic field

which are generated outside of the bundle or are generated by signals passing through other ones of the signal conductors. The shielding strip is advantageously made from the group of electrically conducting compounds consisting of metallised textile, a metal layer, metal foil, metal braid, conducting fluoropolymer filled with metal particles or a combination thereof. Preferably the metal is copper, aluminium, gold or silver or an alloy thereof and most preferably the metal is copper.

[0015] In one embodiment of the invention the insulator comprises an upper insulator attached to a lower insulator. This allows the signal conductors to be placed on the surface of one of the insulators in a defined position and then the other insulator is placed on top of the conductors to hold them in a fixed position. In the preferred embodiment of the invention the upper insulator is laminated to said lower insulator. However, other attachment methods such as the use of adhesive can be used. It is, of course, possible to extrude the insulation with the signal conductors.

[0016] Preferably the upper insulator and said lower insulator are formed from the group of insulating materials consisting of perfluoralkoxy, fluoroethylene-propylene, polyolefin including polypropylene and polyethylene, polymethylpentene, polytetrafluoroethylene or expanded polytetrafluorethylene and most preferably from expanded polytetrafluorethylene (PTFE). Expanded PTFE has a very low dielectric constant and, as a result, offers extremely good electrical signal properties to the bundle.

[0017] The shielding strip is attached to said insulator preferably by lamination although other methods such as the use of adhesives can be used..

[0018] In order to allow the electrical signal conductors to be attached to a termination board, electrical signal conductors are exposed at one end of the electrical signal bundle. Most preferably the electrical signal conductors have a pitch distance which is matched to the distance between termination points on said termination board. This allows simple connection of the individual termination points to the signal conductors within the bundle.

[0019] The electrical signal bundle of the invention can be advantageously used in a catheter.

Description of the Figures

[0020]

Fig. 1 shows an electrical cable according to the invention.
Fig. 2 shows a circuit board to which the electrical cable is to be connected
Fig. 3 shows a perspective drawing of the electrical cable with the coplanar electrical signal conductors and having the shield on a first side of the electrical signal bundle.
Fig. 4 shows a perspective drawing of the electrical cable with the coplanar electrical signal conductors and having the shield on a second side of the electrical signal bundle.
Fig. 5 shows a manufacturing apparatus for the coplanar electrical signal conductors.
Fig. 6 shows a sintering oven for the electrical signal conductors.
Fig. 7 shows an apparatus for carrying out flexlife measurements.

Detailed Description of the Invention

[0021] Fig. 1 shows an electrical signal cable 10 forming a catheter according to the invention. The electrical signal cable 10 is connected at one end to a termination board 20 and at the other end to connectors 30a and 30b. The termination of the electrical signal cable 10 to the termination board 20 and to the connectors 30a and 30b is merely illustrative of possible terminations of the electrical signal cable of the invention and is not intended to be limiting of the invention. The electrical signal cable comprises an electrical signal bundle 40 having a first end 45a and a second end 45b and an outer jacket 50. The outer jacket has a outer jacket ends 55a and 55b. The electrical signal bundle 40 extends beyond the outer jacket ends 55a, 55b.

[0022] Fig. 2 shows one example of the termination board 20 to which the electrical signal cable 10 at the second end 45b may be connected. The termination board 20 has a plurality of contacts 60a and 60b to which each of the electrical signal conductors within the electrical signal cable 10 is connected. The electrical signal conductors will be depicted in later figures. The termination board 20 may be connected to probes 65 used in a medical application. Other applications are contemplated and the use is in a medical device is not limiting of the invention. The contacts 60a and 60b have a pitch distance which is preferably matched to the pitch distance of the electrical signal conductors within the electrical signal cable 10.

[0023] Fig. 3 shows the electrical signal cable 10 of the invention. It depicts the electrical signal bundle 40 within the outer jacket 50. The electrical signal bundle 40 is manufactured - as will be described later - as a planar insulation 80 within which are encased a plurality of coplanar electrical signal conductors 70 having a pitch distance from each other. The planar insulation 80 has a top side 84 and a bottom side 86. A shielding strip 90 is then attached to one of the top side 84 or the bottom side 86 of the planar insulation 80. The electrical signal bundle 40 is then helically wound around

a central axis 60 and placed within the outer jacket 50. In the embodiment depicted in Fig. 3, the shielding strip 90 is placed on the top side 84 of the planar insulation and thus forms an external circumference of the helically wound electrical signal bundle 40. It could also be placed on the bottom side 86 of the planar insulation 80 to form an internal circumference of the helically wound electrical signal bundle 40 as is depicted in Fig. 4. The outer jacket 50 furthermore contains a drain wire 100.

[0024] The electrical signal conductors 70 can be made from any conducting material such as copper, nickel-plated copper, tin-plated copper, silver-plated copper, tin-plated alloys, silver-plated alloys or copper alloys. Preferably the electrical signal conductors 70 are made of round copper wire. It would also be possible to use flat conductors.

[0025] The number of electrical signal conductors 70 depicted in Figs. 3 and 4 are not intended to be limiting of the invention. The axes of the electrical signal conductors 70 are separated by a first pitch distance a which is in the range of 0,1 to 1 mm. The insulator 80 comprises an upper insulating layer 80a and a lower insulating layer 80b which can be made of any insulating dielectric material such as polyethylene, polyester, perfluoralkoxy, fluoroethylene-propylene, polypropylene, polymethylpentene, polytetrafluoroethylene or expanded polytetrafluorethylene. Preferably expanded polytetrafluoroethylene such as that described in US-A-3 953 556, US-A-4 187 390 or US-A-4 443 657 is used.

[0026] The electrical signal bundle 40 is connected at its first end 45a to the connectors 30a, 30b by exposing the electrical signal conductors 70 within the electrical signal bundle by removing all or past of the insulator 80. The electrical signal bundle 40 is connected at its second end 45b by unbundling or untwisting the electrical signal bundle 40 and then exposing at least some of the electrical signal conductors 70 by preferably removing one of the upper insulating layer 80a or the lower insulating layer 80b. This allows direct connection of the exposed conductors 70 to the conductors on the termination board 20.

[0027] In one embodiment of the invention the electrical signal bundle 40 has twenty-one electrical signal conductors 70. Sixteen of the electrical signal conductors 70 carry electrical measurement signals from the probes 65 attached to the termination board 20. Five of the electrical signal conductors 70 carry electrical control signals to the probes 65. The sixteen electrical signal conductors carrying measurement signals need to be shielded from electromagnetic fields outside the electrical signal cable 10 and from electromagnetic fields generated from the electrical control signals. In the embodiment of Fig. 3, the electrical signal conductors 70 carrying the measurement are situated on the outer circumference of the electrical signal bundle 40 so that the shielding strip 90 shields them from stray electromagnetic fields. In the embodiment of Fig. 4, the electrical signal conductors 70 carrying the electrical measurement signals are situated in the inner of the electrical signal bundle 40 where the shielding strip 90 shields them from stray electromagnetic fields from outside the signal bundle 40 and those generated by the electrical control signals.

[0028] The outer jacket 50 is made from silicone or polyolefins such as polyethylene, polypropylene or polyethylpentene; fluorinated polymers such as fluorinated ethylene/propylene (FEP); fluorinated alkoxypolymer such as perfluoro (alkoxy)alkylanes, e.g. a co-polymer of TFE and perfluorproplyvinyl ether (PFA); polyurethane, polyvinylchloride (PVC) or polytetrafluoroethylene (PTFE) or reinforced expanded PTFE (ePTFE). In one embodiment of the invention the outer jacket 50 was made from polyethylene or expanded PTFE reinforced with silicone. The latter outer jacket 50 is available from W.L.Gore & Associates in Phoenix, Arizona, under the trade name SILKORE.

[0029] Manufacture of the electrical signal bundle 40 is illustrated in Fig. 5 for the embodiment in which the upper insulating layer 80a and the lower insulating layer 80b are made from expanded PTFE. This method is essentially the same as that taught in US-A-3082292 (Gore). The same reference numerals are used to denote the components of the electrical signal bundle 40 in this figure as those used for the components of the electrical signal bundle 40 in the embodiments of the invention depicted in Figs. 3 and 4. A plurality of individual signal conductors 70, an upper insulator 80a located above the plurality of individual signal conductors 70, and a lower insulator 80b located below the plurality of individual signal conductors 70 as well as a shielding strip 90 were communally passed between two contra-rotating pressure rollers 110a and 110b at a lamination temperature sufficient to achieve bonding between the lower insulator 80b and the upper insulator 80a, e.g. between 327°C and 410 °C. In the manufacturing embodiment depicted in Fig. 5, the shielding strip 90 is placed on the top side 84 of the insulator 80. However, the same apparatus could be used to place the shielding strip 90 on the bottom side 86 of the insulator 80. The electrical signal bundle 40 was thereby formed. For this purpose, the upper pressure roller 110a is provided with a number of upper peripheral grooves 120a each separated by an upper peripheral rib 130a which are lined up at a distance from one another along the circumference of the pressure rollers 110a. Similarly, the lower pressure rollers 110b is provided with a number of lower peripheral grooves 120b each separated by a lower peripheral rib 130b which are lined up at a distance from one another along the circumference of the pressure roller 110b. Each upper peripheral groove 120a of the upper pressure roller 110a together with the adjacent upper peripheral ribs 130a lines up with one of the lower peripheral grooves 120b with the adjacent lower peripheral ribs 130b of the lower pressure roller 110b to form a passageway channel for one of the electrical signal conductors 70. The distance between the two pressure rollers 110a, 110b and the peripheral grooves 120a, 120b are designed in terms of their dimensions in such a way that a single conductor 70 and the upper insulator 80a and the lower insulator 80b pass continuously between a pair consisting of one of the upper peripheral grooves 120a and one of the lower peripheral grooves 120b. The upper peripheral ribs 130a and the lower peripheral

ribs 130b have such a small separation from one other that the upper insulator 80a and the lower insulator 80b are firmly pressed together at these positions to form an intermediate zone 140 in the electrical signal bundle 40.

[0030] In order to improve their adhesion of the upper insulator 80a to the lower insulator 80b to the individual signal conductors 70 and with each other within the electrical signal bundle 40, the electrical signal bundle 40 was led through a sintering device in which the electrical signal bundle 40 is heated such that one achieves intimate joining in the intermediate zones 140 of the electrical signal bundle 40. If using an upper insulator 80a and a lower insulator 80b made of PTFE, use is made of a sintering temperature in the range from 327° to 410°C.

[0031] An example of an embodiment of a sintering device in the form of a sintering oven 150 comprising a salt bath is illustrated in a schematic and simplified form in Figure 6. In this example electrical signal bundle 40 is continually passed through the sintering oven 150.

Examples

[0032] Table 1 shows the pitch distance a for an electrical signal bundle 40 having a characteristic impedance of 50 Ω compared with electrical signal conductors 70 of AWG (American Wire Gauge) 3801 (outer diameter 0.102 mm), 4001 (outer diameter 0.079 mm), 4201 (outer diameter 0.063 mm) and 4401 (outer diameter 0.051) and insulators made of ePTFE (dielectric constant 1.3), PTFE (dielectric constant 2.1), PES (dielectric constant 3.3). The electrical signal conductors are made of a single strand of copper wire. The shielding strip 90 is formed from a perforated silver-plated copper foil. It should be noted that the dielectric constant of PTFE is identical to that of PFA and FEP and as a result the pitch distance a obtained for PTFE will be identical to that of PFA and FEP.

Table 1

	Pitch distance in mm			
AWG:	**3801**	**4001**	**4201**	**4401**
Insulator:				
ePTFE	0.23	0.17	0.12	0.09
PTFE	0.3	0.22	0.17	0.13
PES	0.42	0.31	0.24	0.19

[0033] Table 2 shows the same material used to obtain an electrical signal bundle 40 having a characteristic impedance of 75 Ω.

Table 2

	Pitch distance in mm			
AWG:	**3801**	**4001**	**4201**	**4401**
Insulator:				
ePTFE	0.39	0.30	0.23	0.18
PTFE	0.58	0.44	0.34	0.27
PES	0.94	0.72	0.57	0.45

[0034] Table 3 shows the use of different insulators 80 to obtain pitch distance a of specified values.

Table 3

Pitch Distance a (mm)	Insulator	AWG	Impedance (Ω)
0.1	ePTFE	4401	52
0.175	ePTFE	4001	51
0.35	ePTFE	3801	70
0.5	PTFE	3801	69
0.635	PES	4001	71

[0035] A further example of an electrical signal cable of was constructed using electrical signal conductors 70 made of AWG 4207 copper wire spaced at a pitch distance of 0.35 mm within an ePTFE insulation 80 having a dielectric

constant of 1.3. A shielding strip 90 was made from copper-coated polyamide foil obtainable from the Statex company of Bremen, Germany. The characteristic impedance of the electrical signal cable 10 was 50 Ω. Flexlife measurements gave a result of around 30 000 cycles.

[0036] The crosstalk between the first one of the electrical signal conductors 70 and the planar insulation was measured to be 19 dB/2.5m Assembly length at 10 MHz and 22.6 dB/2.5 m assembly length at 5 MHz. The impedance of the first one of the electrical signal conductors 70 was measured to be 85 Ω. The attenuation was measured to be 2.25 dB at 10 MHz and 1.88 dB at 5 MHz.

[0037] Although a few exemplary embodiments of the present invention have been described in detail above, those skilled in the art readily appreciate that many modifications are possible without materially departing from the novel teachings and advantages which are described herein. Accordingly, all such modifications are intended to be included within the scope of the present invention, as defined by the following claims.

Claims

1. Electrical signal bundle (40) for placing within an outer jacket (50) and having an outer side, the electrical signal bundle (40) having

   a plurality of coplanar electrical signal conductors (70) encased within an insulator (80) and forming a bundle assembly (40), wherein the insulator has an insulator top side (84) and an insulator bottom side (86),
   a shielding strip (90) placed on one of the insulator top side or the insulator bottom side,
   wherein said bundle assembly (40) is helically twisted around a central axis (60) and
   at least one of the said electrical signal conductors (70) has a characteristic impedance in the range of 50 Ω to 200 Ω.

2. Electrical signal bundle (40) according to claim 1 wherein
   said shielding strip (90) is made from the group of electrically conducting compounds consisting of metallised textile, a metal layer, metal foil, metal braid, conducting fluoropolymer filled with metal particles or a combination thereof.

3. Electrical signal bundle according to claim 2 wherein
   said metal is copper, aluminium, gold or silver or an alloy thereof.

4. Electrical signal bundle according to claim 3 wherein said metal is copper.

5. Electrical signal bundle (40) according to claim 1, wherein the insulator (80) comprises an upper insulator (80a) attached to a lower insulator (80b).

6. Electrical signal bundle (40) according to claim 5, wherein said upper insulator (80a) is laminated to said lower insulator (80b).

7. Electrical signal bundle (40) according to claim 1, wherein said upper insulator (80a) and said lower insulator (80b) are formed from the group of insulating materials consisting of polyester, perfluoralkoxy, fluoroethylene-propylene, polyolefin including polypropylene and polyethylene, polymethylpentene, polytetrafluoroethylene or expanded polytetrafluorethylene

8. Electrical signal bundle (40) according to claim 7, wherein said upper insulator (80a) and said lower insulator (80b) are formed from expanded polytetrafluorethylene.

9. Electrical signal bundle (40) according to claim 1, wherein
   said shielding strip (90) is attached to said insulator (80).

10. Electrical signal bundle (40) according to claim 9, wherein
    said shielding strip (90) is laminated to said insulator (80).

11. Electrical signal bundle (40)according to claim 1 wherein
    the outer diameter of the electrical signal bundle (40) is less than 1,6 mm.

12. Electrical signal bundle (40) according to claim 11 wherein said electrical signal bundle (40) has at least twenty one electrical signal conductors (70).

13. Electrical signal bundle (40) according to claim 1 wherein said electrical signal bundle (40) has at least eight electrical signal conductors (70) with matched characteristic impedance.

14. Electrical signal bundle (40) according to claim 13 wherein said electrical signal bundle (40) has at least sixteen electrical signal conductors (70) with matched characteristic impedance

15. Electrical signal bundle (40) according to claim 1 wherein said electrical signal conductors (70) have an outer diameter of 0,07 mm.

16. Electrical signal bundle (40) according to claim 1 wherein said has a first end (45a) and a second end (45b) and at the first end (45a) the electrical signal conductors (70) are exposed.

17. Electrical signal bundle according to claim 1 wherein at the second end (45b) the bundles is untwisted and the electrical signal conductors (70) are connected to a termination board (20).

18. Electrical signal bundle according to claim 17 wherein the electrical signal conductors (70) have a pitch distance (a) and the distance between termination points on said termination board (20) is matched to said pitch distance (a).

19. Electrical signal bundle (40) according to claim 1 wherein the shielding strip (90) is placed on the insulator top side (84) such that the external circumference of the electrical signal bundle (40) is shielded.

20. Electrical signal bundle (40) according to claim 1 wherein the electrical signal conductors are separated from each other by a pitch distance a and said pitch distance (a) is between 0,1 mm and 10 mm.

21. Electrical signal bundle (40) according to claim 20 wherein said pitch distance (a) is 0,35 mm.

22. Catheter (10) having an outer tube (50), the outer tube having a first tube outer end (55a) and a second tube outer end (55b), within which the electrical signal bundle of one of claims 1 to 20 is placed.

23. Catheter (10) according to claim 21 wherein the bundle (40) first end (45a) extends beyond the first tube outer end (55a).

24. Catheter according to claim 21 wherein the bundle second end (45b) and the termination board (20) extends beyond the second tube outer end (55b).

Patentansprüche

1. Elektrisches Signalbündel (40) zur Anordnung in einem äußeren Mantel (50), das eine Außenseite aufweist, wobei das elektrische Signalbündel (40) folgendes aufweist:

   mehrere koplanare elektrische Signalleiter (70), die in einem Isolator (80) eingeschlossen sind und eine Bündelbaugruppe (40) bilden, wobei der Isolator eine Isolatoroberseite (84) und eine Isolatorunterseite (86) aufweist,
   einen Abschirmstreifen (90), der entweder auf der Isolatoroberseite oder auf der Isolatorunterseite angeordnet ist,
   wobei die Bündelbaugruppe (40) helixförmig um eine Mittelachse (60) gewunden ist, und
   mindestens einer der elektrischen Signalleiter (70) einen Wellenwiderstand im Bereich von 50 Ω bis 200 Ω aufweist.

2. Elektrisches Signalbündel (40) nach Anspruch 1, wobei
   der Abschirmstreifen (90) aus der Gruppe von elektrisch leitenden Zusammensetzungen bestehend aus

metallisiertem Gewebe, einer Metallschicht, Metallfolie, Metallgeflecht, leitendem Fluorpolymer, gefüllt mit Metallpartikeln, oder einer Kombination dieser hergestellt ist.

3. Elektrisches Signalbündel (40) nach Anspruch 2, wobei
das Metall Kupfer, Aluminium, Gold oder Silber oder eine Legierung dieser ist.

4. Elektrisches Signalbündel nach Anspruch 3, wobei das Metall Kupfer ist.

5. Elektrisches Signalbündel (40) nach Anspruch 1, wobei der Isolator (80) einen oberen Isolator (80a) umfaßt, der an einem unteren Isolator (80b) befestigt ist.

6. Elektrisches Signalbündel (40) nach Anspruch 5, wobei der obere Isolator (80a) mit dem unteren Isolator (80b) laminiert ist.

7. Elektrisches Signalbündel (40) nach Anspruch 1, wobei der obere Isolator (80a) und der untere Isolator (80b) aus der Gruppe isolierender Materialien bestehend aus Polyester, Perfluoralkoxy, Fluorethylen-Polypropylen, Polyolefin einschließlich Polypropylen und Polyethylen, Polymethylpenten, Polytetrafluorethylen oder expandiertes Polytetrafluorethylen hergestellt ist.

8. Elektrisches Signalbündel (40) nach Anspruch 7, wobei der obere Isolator (80a) und der untere Isolator (80b) aus expandiertem Polytetrafluorethylen hergestellt sind.

9. Elektrisches Signalbündel (40) nach Anspruch 1, wobei
der Abschirmstreifen (90) an dem Isolator (80) befestigt ist.

10. Elektrisches Signalbündel (40) nach Anspruch 9, wobei
der Abschirmstreifen (90) mit dem Isolator (80) laminiert ist.

11. Elektrisches Signalbündel (40) nach Anspruch 1, wobei
der Außendurchmesser des elektrischen Signalbündels (40) kleiner als 1,6 mm ist.

12. Elektrisches Signalbündel (40) nach Anspruch 11, wobei das elektrische Signalbündel (40) mindestens einundzwanzig elektrische Signalleiter (70) aufweist.

13. Elektrisches Signalbündel (40) nach Anspruch 1, wobei
das elektrische Signalbündel (40) mindestens acht elektrische Signalleiter (70) mit angepaßtem Wellenwiderstand aufweist.

14. Elektrisches Signalbündel (40) nach Anspruch 13, wobei
das elektrische Signalbündel (40) mindestens sechzehn elektrische Signalleiter (70) mit angepaßtem Wellenwiderstand aufweist.

15. Elektrisches Signalbündel (40) nach Anspruch 1, wobei
die elektrischen Signalleiter (70) einen Außendurchmesser von 0,07 mm aufweisen.

16. Elektrisches Signalbündel (40) nach Anspruch 1, wobei das elektrische Signalbündel (40) ein erstes Ende (45a) und ein zweites Ende (45b) aufweist und die elektrischen Signalleiter (70) an dem ersten Ende (45a) freigelegt sind.

17. Elektrisches Signalbündel nach Anspruch 1, wobei an dem zweiten Ende (45b) das Bündel entwunden ist und die elektrischen Signalleiter (70) mit einer Abschlußkarte (20) verbunden sind.

18. Elektrisches Signalbündel nach Anspruch 17, wobei die elektrischen Signalleiter (70) einen Rasterabstand (a) aufweisen und der Abstand zwischen Abschlußpunkten auf der Abschlußkarte (20) an den Rasterabstand (a) angepaßt ist.

19. Elektrisches Signalbündel (40) nach Anspruch 1, wobei
der Abschirmstreifen (90) so auf der Isolatoroberseite (84) angeordnet ist, daß der äußere Umfang des elektrischen Signalbündels (40) abgeschirmt ist.

20. Elektrisches Signalbündel (40) nach Anspruch 1, wobei die elektrischen Signalleiter mit einem Rasterabstand (a) voneinander getrennt sind und der Rasterabstand (a) zwischen 0,1 mm und 10 mm liegt.

21. Elektrisches Signalbündel (40) nach Anspruch 20, wobei der Rasterabstand (a) 0,35 mm beträgt.

22. Katheter (10) mit einer äußeren Röhre (50), wobei die äußere Röhre ein erstes äußeres Röhrenende (55a) und ein zweites äußeres Röhrenende (55b) aufweist, worin das elektrische Signalbündel nach einem der Ansprüche 1 bis 20 angeordnet wird.

23. Katheter (10) nach Anspruch 22, wobei sich das erste Ende (45a) des Bündels (40) über das erste äußere Röhrenende (55a) hinaus erstreckt.

24. Katheter (10) nach Anspruch 22, wobei sich das zweite Ende (45b) des Bündels mit der Abschlußkarte (20) über das zweite äußere Röhrenende (55b) hinaus erstreckt.

Revendications

1. Faisceau de signal électrique (40) destiné à être logé dans une gaine externe (50) et présentant un côté extérieur, le faisceau de signal électrique (40) comportant

   une pluralité de conducteurs de signal électrique coplanaires (70) logés dans un isolant (80) et formant un faisceau (40) dans lequel l'isolant présente un côté haut d'isolant (84) et un côté bas d'isolant (86) ;
   une bande de blindage (90) placée sur un côté haut d'isolant ou côté bas d'isolant ;
   où ledit faisceau (40) est torsadé en hélice autour d'un axe central (60) et
   au moins l'un desdits conducteurs électriques (70) présente une impédance caractéristique comprise entre 50 Ω et 200 Ω.

2. Faisceau de signal électrique (40) selon la revendication 1, dans lequel ladite bande de blindage (90) est réalisée dans le groupe de composés conducteurs d'électricité incluant le tissu métallisé, la couche métallique, le film métallique, la tresse métallique, le fluoropolymère conducteur rempli de particules métalliques ou une composition de ceux-ci.

3. Faisceau de signal électrique selon la revendication 2, dans lequel ledit métal est du cuivre, de l'aluminium, de l'or ou de l'argent ou un alliage de ceux-ci.

4. Faisceau de signal électrique selon la revendication 3, dans lequel ledit métal est du cuivre.

5. Faisceau de signal électrique (40) selon la revendication 1, dans lequel l'isolant (80) comprend un isolant supérieur (80a) fixé à un isolant inférieur (80b).

6. Faisceau de signal électrique (40) selon la revendication 5, dans lequel ledit isolant supérieur (80a) est laminé sur ledit isolant inférieur (80b).

7. Faisceau de signal électrique (40) selon la revendication 1, dans lequel ledit isolant supérieur (80a) et ledit isolant inférieur (80b) sont formés dans le groupe de matériaux isolants incluant le polyester, le perfluoralkoxy, le fluoroéthylène-propylène, la polyoléfine incluant le polypropylène et le polyéthylène, le polyméthylpentène, le polytétrafluoroéthylène ou le polytétrafluoroéthylène expansé.

8. Faisceau de signal électrique (40) selon la revendication 7, dans lequel ledit isolant supérieur (80a) et ledit isolant inférieur (80b) sont réalisés en polytétrafluoroéthylène expansé.

9. Faisceau de signal électrique (40) selon la revendication 1, dans lequel ladite bande de blindage (90) est fixée audit isolant (80).

10. Faisceau de signal électrique (40) selon la revendication 9, dans lequel ladite bande de blindage (90) est laminée sur ledit isolant (80).

11. Faisceau de signal électrique (40) selon la revendication 1, dans lequel le diamètre extérieur du faisceau de signal électrique (40) est inférieur à 1,6 mm.

12. Faisceau de signal électrique (40) selon la revendication 11, dans lequel ledit faisceau de signal électrique (40) comprend au moins vingt et un conducteurs de signal électrique (70).

13. Faisceau de signal électrique (40) selon la revendication 1, dans lequel ledit faisceau de signal électrique (40) comprend au moins huit conducteurs de signal électrique (70) ayant des caractéristiques d'impédance identiques.

14. Faisceau de signal électrique (40) selon la revendication 13, dans lequel ledit faisceau de signal électrique (40) comprend au moins seize conducteurs de signal électrique (70) ayant des caractéristiques d'impédance identiques.

15. Faisceau de signal électrique (40) selon la revendication 1, dans lequel lesdits conducteurs de signal électrique (70) ont un diamètre extérieur de 0,07 mm.

16. Faisceau de signal électrique (40) selon la revendication 1, dans lequel celui-ci comprend une première extrémité (45a) et une deuxième extrémité (45b) et les conducteurs de signal électrique (70) sont exposés à la première extrémité (45a).

17. Faisceau de signal électrique selon la revendication 1, dans lequel à la deuxième extrémité (45b) le faisceau n'est pas torsadé et les conducteurs de signal électrique (70) sont raccordés à une carte de terminaison (20).

18. Faisceau de signal électrique selon la revendication 17, dans lequel les conducteurs de signal électrique (70) présentent une résistance de pas (a) et la distance entre les points de terminaison et ladite carte de terminaison (20) est adaptée en fonction de ladite résistance de pas (a).

19. Faisceau de signal électrique (40) selon la revendication 1, dans lequel la bande de blindage (90) est placée sur le côté haut de l'isolant (84) de manière à ce que la circonférence extérieure du faisceau de signal électrique (40) soit blindée.

20. Faisceau de signal électrique (40) selon la revendication 1, dans lequel les conducteurs de signal électrique sont séparés les uns des autres par une distance de pas a et ladite distance de pas (a) est comprise entre 0,1 mm et 10 mm.

21. Faisceau de signal électrique (40) selon la revendication 20, dans lequel ladite distance de pas (a) est égale à 0,35 mm.

22. Cathéter (10) muni d'un tube extérieur (50), le tube extérieur présentant une première extrémité extérieure de tube (55a) et une deuxième extrémité extérieure de tube (55b), dans lequel est placé le faisceau de signal électrique de l'une des revendications 1 à 20.

23. Cathéter (10) selon la revendication 21, dans lequel la première extrémité (45b) du faisceau (40) s'étend au-delà de la première extrémité extérieure du tube (55a).

24. Cathéter selon la revendication 21, dans lequel la deuxième extrémité (45b) du faisceau et la carte de terminaison (20) s'étendent au-delà de la deuxième extrémité extérieure du tube (55b).

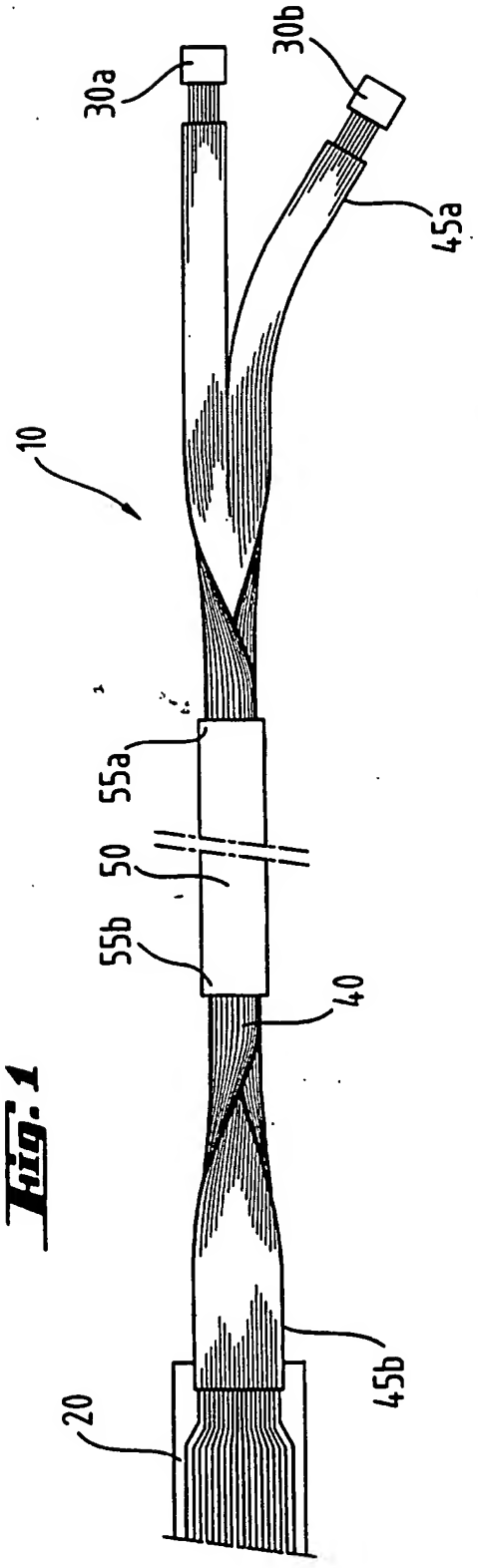

Fig. 1

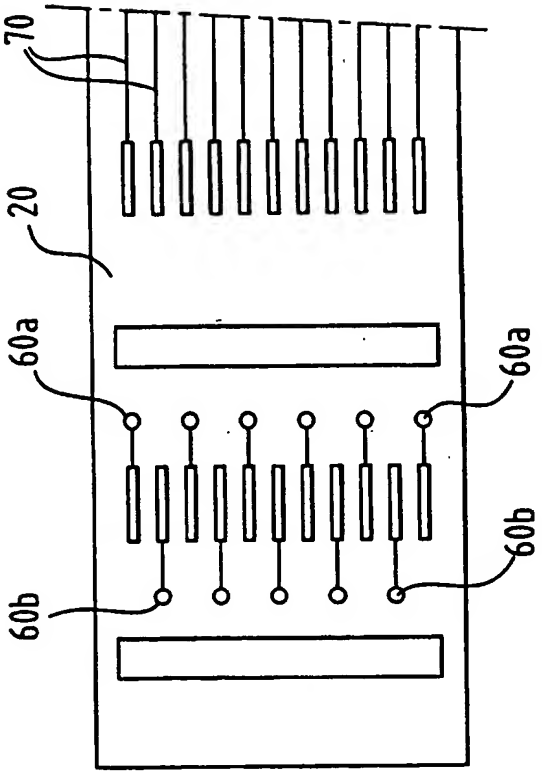

Fig. 2

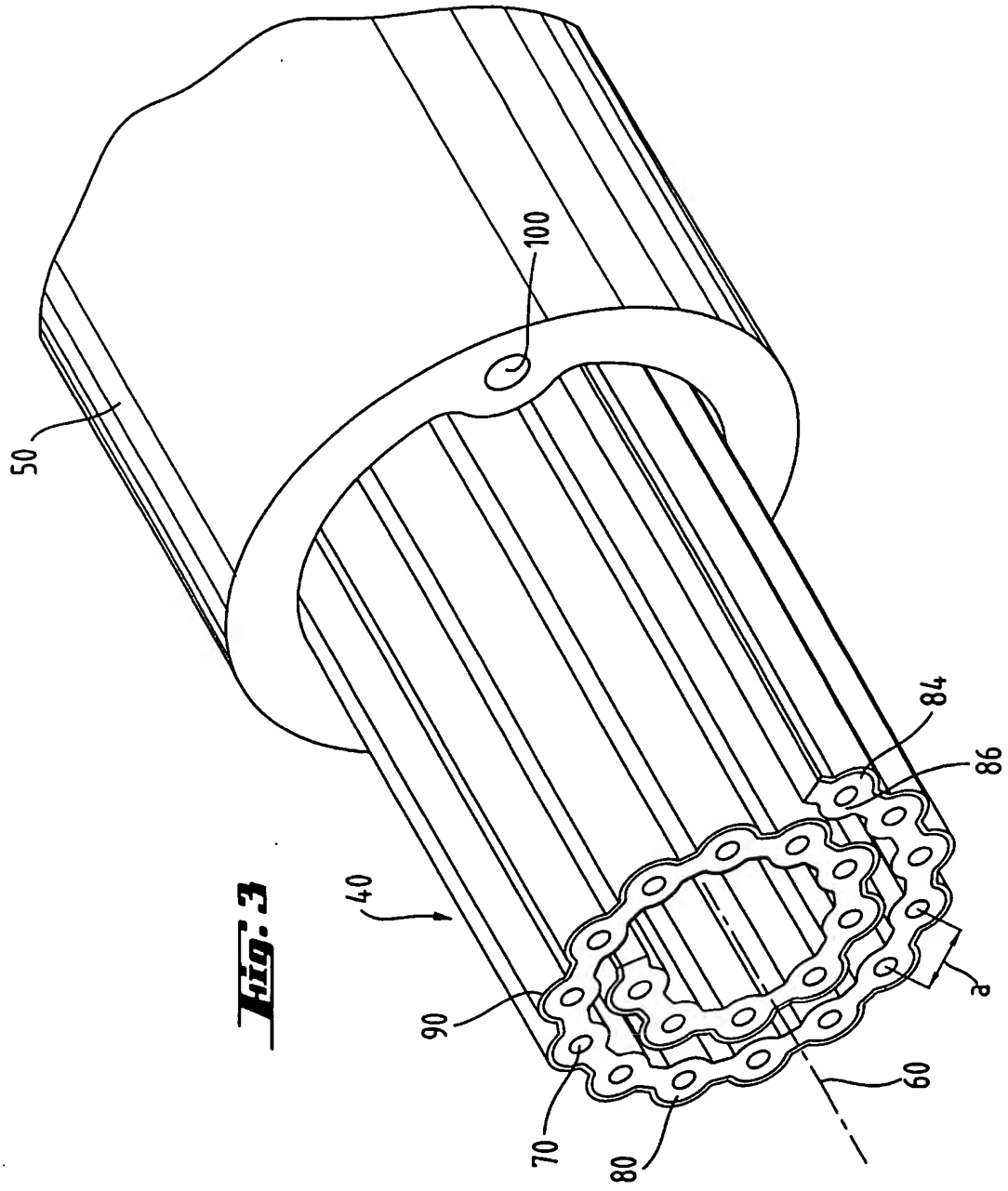

Fig. 3

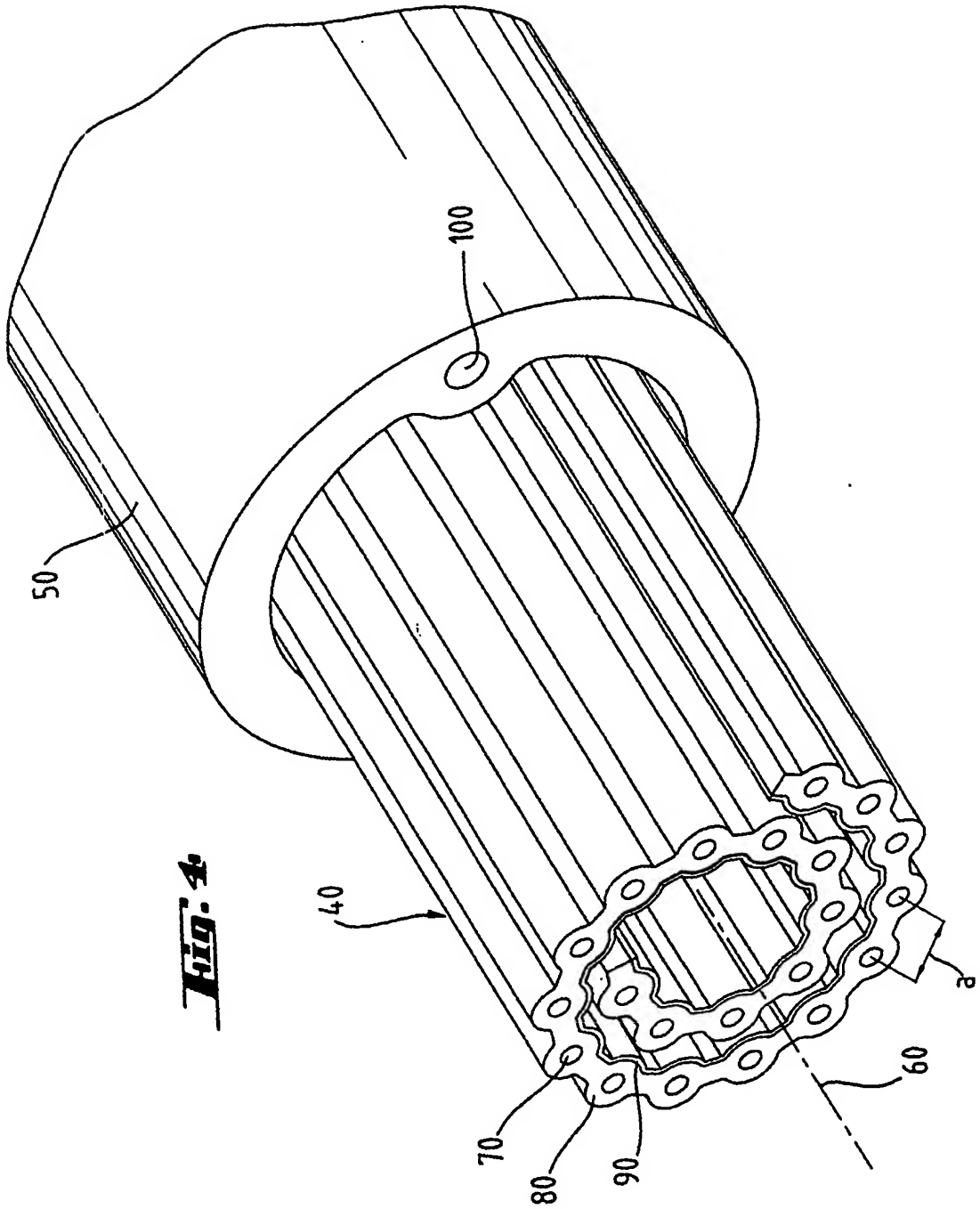

Fig. 4

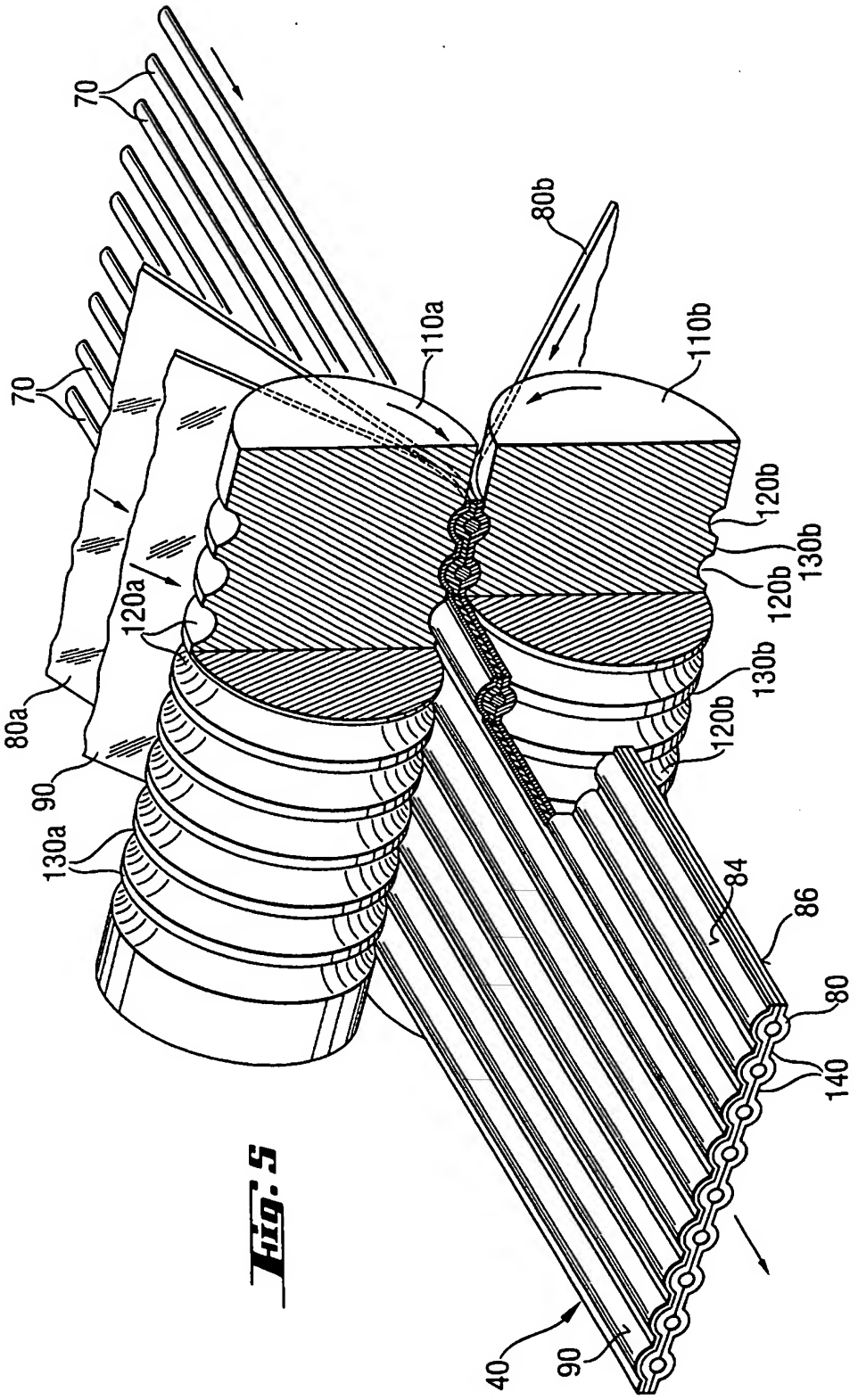
70
70
80b
110a
110b
120b
130b
120b
120a
130b
120b
80a
90
130a
84
86
80
140
40
90

Fig. 5

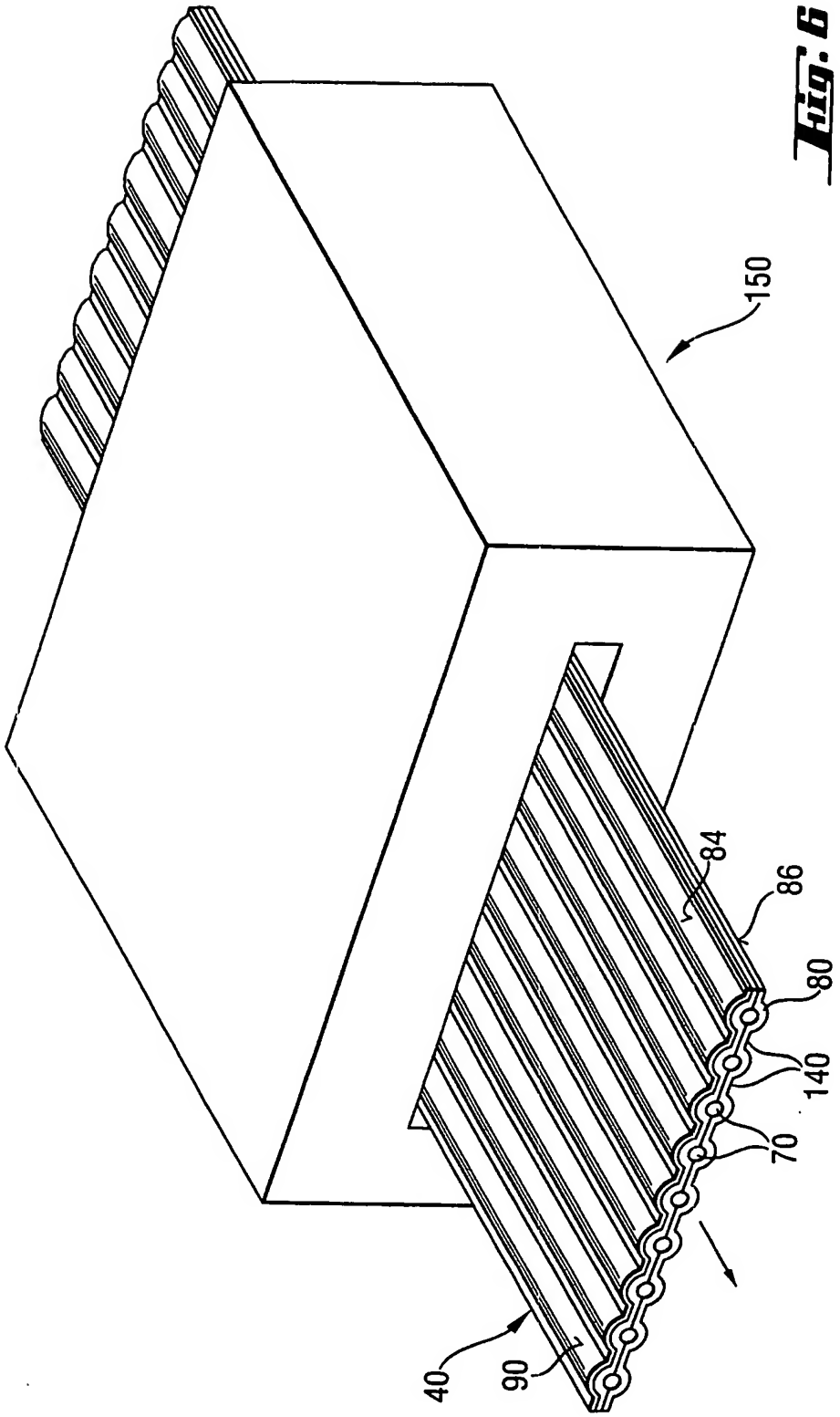

Fig. 6